

important engineering structures. There is no obstacle to this being done, provided the matter is taken up with the merchants who handle this business. Provision has been made for a reduction of working stresses in the case where steel is used the strength of which is not fully established by documentary evidence.

A word of caution is necessary with regard to the use of the modern quick-hardening cements, for which there is at present no standardization. In the use of ordinary cement there is no such doubt.

*State Supervision.*—At the outset it appeared inevitable to the Committee that some adequate supervision by the State over building-work throughout the country was necessary. In view of what we now know of the earthquake risk in New Zealand and of bad building practices in vogue prior to the Hawke's Bay earthquake, it appears advisable that the State should exercise a general supervision over the building by-laws of local bodies, and should exercise such control as will ensure that these by-laws are satisfactorily enforced. The portions of the proposed Dominion Building Code which the Committee has formulated have been prepared on the assumption that legislation of this nature will be enacted.

*Acknowledgments.*—Communication has been established with the leading authorities in California through the Department of Scientific and Industrial Research, as well as through one of the members of the Committee, Mr. A. S. Mitchell. California has been wrestling with the preparation of a satisfactory code since the San Francisco earthquake in 1906, and more particularly since the Santa Barbara earthquake of 1925. None of its codes appear to have been entirely successful, and an influential body is now at work on the preparation of a Californian standard code. This code is not completed, but drafts of portions thereof have reached us and certain extracts have been made use of in this report. In particular, the Committee is indebted to Mr. Henry D. Dewell, of San Francisco, and Professor Bailey Willis, of Stanford University, for their assistance and advice.

This opportunity is taken of acknowledging that extracts have also been taken from the publications of the Californian Building Officials' Conference, the Canadian Standards Association, and the British Institution of Structural Engineers respectively.

Grateful acknowledgment must also be made of the valuable assistance rendered by the Building Research Station of the British Department of Scientific and Industrial Research in the preparation of a special bibliography dealing with earthquake-resistant construction and in connection with special reports of the Steel Structures Research Committee.

A certain amount of information has reached us from Japan, but we expect to receive further data from this source, and also from Italy. It is appropriate here to point out that there is great activity in Britain at the present time in building research, and an important organization has recently been set up to improve the building legislation of Great Britain. New Zealand should keep in close touch with the latest developments of other countries and make full use of them in its own legislation. Nevertheless, a certain amount of original work is required in relation to our own special problems of climate, and, in particular, to our own building-materials. Work has already been done on our timbers. Our cement is of high quality and regularity, being uniformly up to British standard, but some standardization work is desirable on our lime and bricks. With regard to steel, we cannot do better than continue the use of British steel.

*General.*—The precise nature of the destructive action of earthquakes on structures is obscure, and is a subject which is being investigated at the present time in all seismically active countries. Further, to quote the Japanese authority, Dr. Naito, "The science of earthquake-proof construction is so mystical, we all must do our best to uncover the nature of safe and economical building." The design of buildings to resist earthquake forces is one of the major engineering problems of the day. It follows, therefore, that the conclusions which have been reached by the Committee must be regarded as tentative, and subject to amendment from time to time as further knowledge accrues. In this connection, it is recommended that a permanent New Zealand Earthquake Investigation Committee, modelled on the Japanese organization, should be set up.

The destructive forces near to the epicentre or on the line of a big earth-movement may be so great that no building of feasible design can withstand them. All we can hope to do, therefore, is to provide a reasonable margin of safety for the usual building of the domestic or business class, and to choose such a construction that complete collapse is unlikely. In cases where important public services are involved, however, and in places of public assembly, the standard of construction should be appreciably raised. For example, in a large theatre, electric power-house, drainage or fire station, and in structures vital to the maintenance of transport